Journal of Scientific Research and Reports

Volume 30, Issue 9, Page 845-849, 2024; Article no.JSRR.121189
ISSN: 2320-0227

Assessment of Genetic Variability, Heritability and Genetic Advance in Bottle Gourd [*Lagenaria siceraria* (mol.) Standl.] Genotypes

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/jsrr/2024/v30i92411

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/121189

Original Research Article

Received: 10/06/2024
Accepted: 12/08/2024
Published: 05/09/2024

ABSTRACT

The present study highlights about Genetic variability, heritability and genetic advance in bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] genotypes. Experimental material for the study consisted of 25 genotypes including a check (Narendra Kamna). Observations were recorded on fifteen quantitative characters. The analysis of variance for the design of experiment indicated highly

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Cite as: *Das, Trisha, Anil Kumar, C. N. Ram, Virendra Kumar, Vipin, and Shubham Patel. 2024. "Assessment of Genetic Variability, Heritability and Genetic Advance in Bottle Gourd [Lagenaria Siceraria (mol.) Standl.] Genotypes". Journal of Scientific Research and Reports 30 (9):845-49. https://doi.org/10.9734/jsrr/2024/v30i92411.*

significant differences among the genotypes for fourteen characters. Based on mean performance of fruit yield and yield components genotypes, PBR-3 followed by Narendra Pooja, BG-131-1 and Pant Lauki were found as significant and most promising genotypes. High phenotypic along with genotypic coefficients of variation was observed in case of fruit yield per ha, fruit yield per plant, average fruit weight, fruit length indicating possibility of obtaining higher selection response in respect of these traits. High heritability coupled with genetic advance was shown in the characters like fruit yield per plant, average fruit weight and fruit length.

Keywords: Genetic variability; heritability; genetic advance; genotypes; fruit yield.

1. INTRODUCTION

The bottle gourd, also known as “Lauki” [*Lagenaria siceraria* (Mol.) Standl.], is a diploid chromosomal vegetable that is highly popular in India. It is a member of cucurbitaceae family. It goes by the names Calabash gourd and white flowered gourd as well. The fruits are available in the market all year round and are cultivated throughout both the summer and the wet seasons. The bottle gourd is the most widely produced cucurbitaceous vegetable in the world, and it is favored by people living in both rural and urban areas. Africa is where bottle gourds originated. It was concluded that this plant is most likely native to Tropical Africa. The total area covered under bottle gourd cultivation in India, is 193 thousand hectares with a production of 3171 thousand metric tons [1,2]. Bihar, Uttar Pradesh, Madhya Pradesh, Haryana, and Chhattisgarh states are the top producers of bottle gourd.

“Bottle gourd is monoecious, annual vine with soft pubescence. The leaves are cordate – ovate to reniform – ovate, 15-30 cm across, not lobed. The flowers are white, solitary, showy and open at night. The flowers have five petals. The staminate flowers are on long pedicels exceeding the foliage. The pistillate flowers are single with short peduncle and hairy ovary. Bottle gourd requires a well-drained soils with a pH between 6-7, for optimum growth. Although it may grow in many kinds of soil, loamy or sandy loam soils are said to be the ideal. It is semi-arid adapted and requires a well-distributed rainfall of 600 to 1500 mm. The ideal temperature range for germination is between 20–25°C; below 15°C and beyond 35°C, the germination rate is hampered” [3,4].

“Bottle gourd is well known for its wide range of culinary uses and also possible health benefits because of its high fiber content, lower calorie count, and high vitamin and mineral content. The edible part of bottle gourd fruit is composed of 96.1 percent water, 0.1 percent fat, 2.5 percent carbs, 0.2 percent protein, and 2.0 percent fiber. It provides a cooling effect and is very digestible, making it ideal for use during recuperation” [5-6].

“The bottle gourd fruit is commonly shaped like a bottle, but it can also be found in India in rectangular, oval and spherical shapes. The skin of the immature fruit is light green to yellowish green in color or cream in color. Its texture is quite soft, with large white seeds and white flesh. Bark is used as a vegetable and to make desserts like halwa, kheer, petha, and barfi after it has been peeled” [7].

“The extent of genetic variability of existing genotype of a crop plant is an index of its genetic dynamics. Plant breeding revolves around selection which can be effectively practiced only in the presence of variability of desired traits. Heritability and genetic advance are important parameters. Heritability is good index of transmission of characters from parents to their offspring. Genetic advance is the measure of genetic gain under selection. Thus, genetic advance denotes the improvement in the mean genotypic value of selected population over the parental population. Heritability estimates along with genetic advance are more helpful in predicting the improvement that can be made in a crop by selecting the elite genotypes for various characters” [6,8].

2. MATERIALS AND METHODS

The present experiment was conducted at Main Experiment Station of Department of Vegetable Science at the Narendra Deva University of Agriculture & Technology, Narendra Nagar (Kumarganj), Ayodhya (U.P.) during summer season 2023. Twenty-five morphologically diverse bottle gourd genotypes were collected from different places in India. The experiment was conducted in Randomized Block Design with three replications. Individual plot dimension was 3 m × 3 m with a row to row spacing of 3 m and plant to plant spacing of 50 cm. Thus, six plants

were maintained in individual plots. All the recommended agronomic package of practices and plant protection measures were followed to raise a healthy crop stand. The observation was recorded for six selected plants for twelve characters viz., days to first staminate flower anthesis, days to first pistillate flower anthesis, node number to first staminate flower appearance, node number to first pistillate flower appearance, vine length (cm), primary branches per plant, internodal length (cm), fruit length (cm), fruit circumference (cm), average fruit weight (kg), number of fruit per plant, total soluble solids (TSS), dry weight (g) and fruit yield per plant. The data on fifteen characters were utilized for estimation of genotypic and phenotypic coefficient of variation, heritability in broad sense, genetic advance and genetic advance in per cent of mean.

3. RESULTS AND DISCUSSION

Analysis of variance was carried out fifteen characters for 25 genotypes from the experiment were subjected to analysis of variance. Mean sum of squares due to genotypes were highly significant for all the characters except fruit girth and Inter-nodal length (Table 1), indicating that there are significant differences among the genotypes with respect to the characters under study.

Value of mean performance for edible fruit polar length ranged from 49.79 cm (NDBG-131-1) to 22.53 cm (Narendra Kamna) while general mean of the character was 38.27 cm. Highest fruit length was observed in the genotypes NDBG-131-1 (49.79 cm), Narendra Rashmi (48.50 cm), Narendra Pooja (47.49 cm) and Pusa Naveen (44.44 cm). Fruit girth ranged from 19.88 cm (Kashi Kirti) to 41.89 (BRBG-21). While general mean of the character was 28.15 cm. Highest fruit girth was observed in the genotypes BRBG-21 (41.89) followed by PBR 2 (41.59), PBR 3 (34.79) and PBR 1 (33.92). Average fruit weight ranged from 0.62 (Pusa Naveen) to 1.87 kg (PBR 3). While general mean of the character was 1.23 kg. Highest average fruit weight was observed in the genotypes PBR 3 (1.87) followed by NDBG-131-1 (1.60), Pant Lauki (1.52) and NDBG-65-1 (1.51). Fruits per plant ranged from 2.33 (PBR 2 & NDBG-8) to 4.21 (Narendra Pooja). While general mean of the character was 3.29. Highest numbers of fruits were observed in the genotypes Narendra Pooja (4.21) followed by BRB -21(3.87), Arka Bahar (3.87) and PBR 3 (3.80). Fruit yield per plant varies from 2.14 (PBR 2) to 7.09 (PBR 3). While general mean of the character was 4.08. Highest fruit yield per plant was observed in PBR 3 (7.09) followed by Narendra Pooja (6.05), NDBG-131-1 (5.58) and Pant Lauki (5.20).

The estimates of coefficients of variation relieved that magnitude of phenotypic coefficients of variation (PCV) was higher than the genotypic coefficient of variation (GCV) for all the characters. High estimates of phenotypic coefficients of variation were observed in case of fruit yield per plant (32.22%) , fruit girth (29.93%), average fruit weight (23.58%), node at first staminate flower appearance (21.57 %), fruit length (21.51%), while moderate phenotypic coefficient of variation were observed for the characters, node at first pistillate flower appearance (18.99%), fruits per plant (16.61%), primary branches per plant (14.95%), TSS (12.11), dry weight (11.81%), internodal length (11.12). However low phenotypic coefficient of variation was observed in character viz. Internodal length (9.69%), days to first staminate flower anthesis (7.08%), days to pistillate flower anthesis (6.11%) and days to first fruit harvest (4.48). Highest genotypic coefficient of variation was recorded for the character fruit yield per plant (30.05), average fruit weight (22.18%) and fruit length (20.39%) while moderate genotypic coefficient of variation were observed for the characters node at first staminate flower appearance (18.79%), node at first pistillate flower appearance (16.60%), fruits per plant (14.14%), TSS (11.42%), dry weight (10.78%) ad primary branches per plant (10.33%). However low genotypic coefficient of variation was observed in character viz. fruit girth (9.24%), vine length (5.72%), days to first staminate flower anthesis (5.10%), days to first pistillate flower anthesis (4.45%), internodal length (3.72%) and days to first fruit harvest (3.08.).

The estimates of high heritability (>75%) was calculated for the characters fruit length, average fruit weight (89%), TSS (88.9%), fruit yield per plant (87%), dry weight (83.3%), node at first pistillate flower appearance (76.4%), node at first staminate flower appearance (75.9%). However, moderate heritability (>50% and <75%) was recorded in fruits per plant (72.5%), days to first pistillate flower anthesis (53.1%), days to first staminate flower anthesis (51.9% and lower heritability (<50%) was recorded for remaining characters i.e. primary branches per plant (47.9%), days to first fruit harvest (47.1%), vine length (35%), internodal length (11.2%) and fruit girth (9.5%). Ahmad et al*.,* [9] also reported similar result among fourty-five bottle gourd.

Table 1. Estimates of range, phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability in the broad sense and Genetic advance in per cent of mean for fifteen characters in bottle gourd germplasm

	Range		GCV	PCV	h^2 (Broad Sense) %	Gen. Adv. as % of Mean 5%
	Lowest	Highest				
Days to first staminate flower anthesis	46.33	57.33	5.102	7.085	51.9	7.57
Days to first pistillate flower anthesis	51.67	63.33	4.454	6.115	53.1	6.682
Node at which first male appear	2.30	5.53	18.793	21.567	75.9	33.734
Node at which first female flower appear	3.60	7.70	16.609	18.996	76.4	29.914
Primary branches per plant	2.20	3.50	10.339	14.946	47.9	14.734
Vine length (m)	5.70	7.68	5.729	9.689	35	6.98
Intermodal length (cm)	9.14	12.04	3.722	11.12	11.2	2.566
Days to first fruit harvest	63.33	76.00	3.078	4.485	47.1	4.352
Fruit length (cm)	22.53	49.79	20.386	21.51	89.8	39.799
Fruit girth (cm)	19.88	41.89	9.244	29.931	9.5	5.881
Average fruit weight (kg)	0.62	1.87	22.184	23.517	89	43.108
Fruits per plant (no.)	2.33	4.21	14.143	16.61	72.5	24.807
TSS (^{o}brix)	2.30	3.47	11.42	12.113	88.9	22.178
Dry weight (g)	2.56	3.76	10.785	11.814	83.3	20.282
Fruit yield per plant	2.14	7.09	30.057	32.22	87	57.761

The genetic advance in per cent of mean varied from 2.56% (internodal length) to 57.76% (fruit yield per plant). The high genetic advance in per cent of mean (>20%) were highest for fruit yield per plant (57.76 %), average fruit weight (43.11 %), fruit length (39.79%), node at first staminate flower appearance (33.73%), node at first pistillate flower appearance (29.91%), fruits per plant (24.80%), TSS (22.18%), dry weight (20.28%). It is to be noticed that these traits also showed high estimates of broad sense heritability. The low values of genetic advance in per cent of mean (0-10%) showed for primary branches per plant (14.73%), days to first staminate flower anthesis (7.57%), vine length (6.98%), days to 50% pistllate flower anthesis (6.68%) fruit girth (5.58%) days to first fruit harvest (4.35%) and internodal length (2.56). Similar results were also reported Chandramouli et al*.,* [10] Duhan et al*.,* [11].

4. CONCLUSION

It is concluded that the PCV and GCV were high for fruit yield per plant, average fruit weight and fruit length. This indicates possibility of obtaining higher selection response in respect of these traits for yield improvement. High heritability, combined with high genetic advance in percentage of mean genetic advance, was observed for node number of first staminate to pistillate flower appearance, vine length, average fruit weight, number of fruits per plant, and fruits yield per plant. These six characters provided a very high selection response, indicating that heritability was most likely due to additive gene effects.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

ACKNOWLEDGEMENT

I express my wholehearted gratitude and sincere thanks to my Advisor Dr. Anil Kumar, Department of Vegetable Science, College of Horticulture and Forestry, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya, for suggesting me this interesting research work and for all his scholarly guidance, keen interest, support and suggestive criticism throughout the course of this investigation and preparation of this research, despite his multidimensional responsibilities, he has graciously extended his kind cooperation, support and encouragement.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/121189